

Compositional Changes Observed in the Calcified Cartilage and Subchondral Bone in a Monkey Model of Osteoarthritis

Beamline: U10B

Technique: Infrared
Microspectroscopy

Researchers:

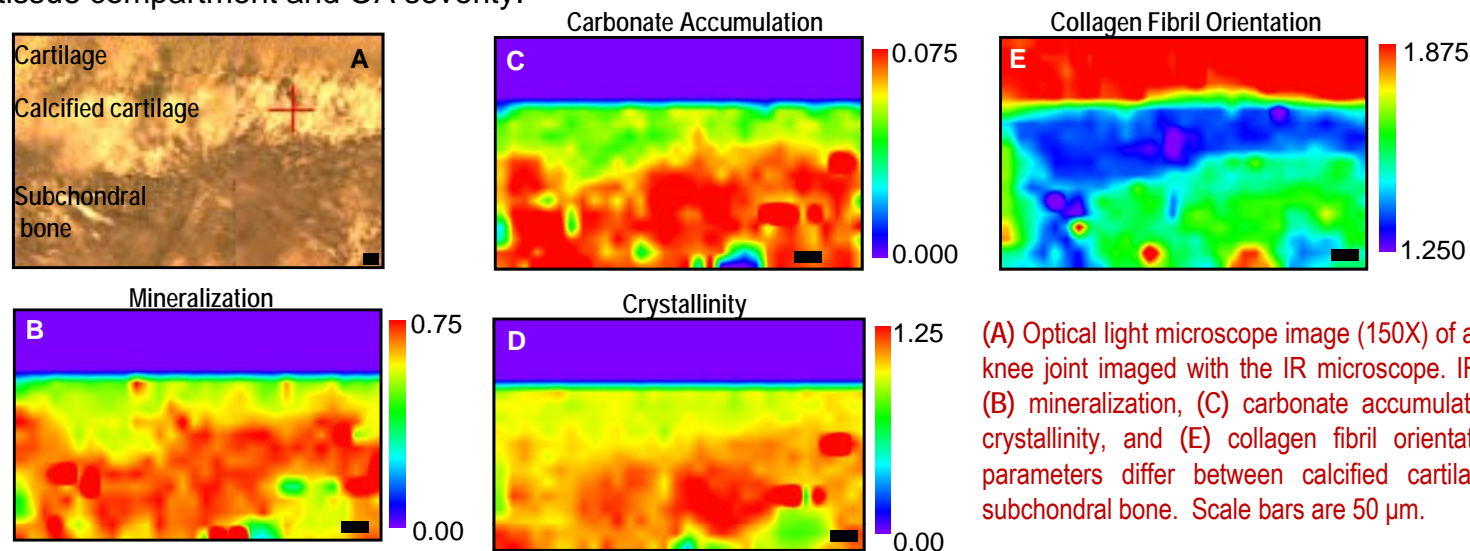
Meghan E. Ruppel, Lisa M. Miller (BNL-NSLS); Cathy S. Carlson (Univ. of Minnesota)

Publications:

L.M. Miller, J. Tetenbaum Novatt, D. Hamerman, C.S. Carlson. *Bone*, 35 (2): 498-506 (2004).

M.E. Ruppel, C.S. Carlson, L.M. Miller. *In preparation*

Motivation: Osteoarthritis (OA) can be a debilitating disease that is characterized by fibrillation and calcification of the articular cartilage and thickening of the subchondral bone. In the present study, the chemical makeup of both the calcified cartilage and subchondral bone were studied in a primate model of OA. Mid-coronal sections of proximal tibia from cynomolgus monkeys were examined. Synchrotron-assisted Fourier transform infrared microscopy (FTIRM) was used to determine the level of mineralization (mineral/protein ratio), carbonate accumulation (carbonate/phosphate ratio), and collagen fibril orientation (amide I/II band ratio) as a function of tissue compartment and OA severity.



Results: Results showed that the level of mineralization ($p=0.0431$) and carbonate accumulation ($p<0.0001$) were significantly higher in subchondral bone when compared to calcified cartilage. The amide I/II ratio was also significantly different between the subchondral bone and calcified cartilage, suggesting differences in collagen organization between the two tissue compartments. As a function of OA severity, the mineralization level of the calcified cartilage increased ($p=0.0037$), but the subchondral bone remained unchanged. The collagen orientation was not affected by OA severity. Compositional differences between calcified cartilage and subchondral bone suggest subchondral bone is older, more mature tissue. Additionally compositional changes that are observed as a function of OA severity are consistent with the progression of a “mineralization front” where endochondral ossification occurs and calcified cartilage is replaced by subchondral bone. These findings indicate that calcified cartilage and subchondral bone have distinctly different collagen structure and mineral composition that are affected by OA severity and could increase stress on the afflicted joints.